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Dynamical conductivity of the extreme concentration 2DEGs in $GdTiO_3/SrTiO_3$ heterostructures DANIEL OUELLETTE, Dept. of Physics, University of CA, Santa Barbara, POUYA MOETAKEF, Materials Dept., University of CA, Santa Barbara, CHRISTOPHER MORRIS, Dept. of Physics and Astronomy, John Hopkins University, MARK SHERWIN, Dept.of Physics and Institute for Terahertz Science and Technology, University of CA, Santa Barbara, S. JAMES ALLEN, Dept. of Physics, University of CA, Santa Barbara, SUSANNE STEMMER, Materials Department, University of CA, Santa Barbara — Metallic conductivity with extremely high 2D carrier concentration is observed at the interface between the Mott insulator $GdTiO_3$ and the band insulator $SrTiO_3$. Irrespective of layer thickness or repeats, MBE-grown $GdTiO_3/SrTiO_3$ heterostructures have carrier density of approximately 1/2 electron per interface unit cell, or 3×10^{14} cm^{-2} per interface, in excellent agreement with the polar discontinuity model. To probe the orbital character, confinement, and correlations of carriers in this system we have measured the static (dc) and dynamical conductivity of a variety of heterostructures, using a combination of THz time-domain and FTIR spectroscopies. Samples with $SrTiO_3$ layers exceeding $\sim$10 nm thickness exhibit a Drude conductivity that may arise from d_{xz} and d_{yz} electric subbands at the interface. A discrepancy between the measured dynamical and dc conductivity measurements indicates the presence of a few additional carriers with very low scattering rate. By contrast, the Drude response of samples with thinner SrTiO3 layers shows an increased scattering rate with excellent agreement between the dc and THz frequency dynamical conductivity.

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